Learnercube: Educational game discovery and recommendation application.

Omasirichukwu Udeinya
Georgia Institute of
Technology,USA
oudeinya3@gatech.edu

ABSTRACT
This paper briefly discusses some pedagogical strategies that teachers use to engage students and increase motivation and learning outcomes. Then it follows with a discussion of educational games and the implementation details of Learnercube, a game discovery and recommendation web app.

Author Keywords
Game based learning, Project based learning, Problem based learning, LearnerCube.

INTRODUCTION
Technology creates new possibilities and changes the way people carry out their normal activities. The familiar theme is that proper application of technology makes people more efficient and allows them to do things in ways previously not possible. The increase in internet penetration and mobile device usage has created opportunities for technology companies in all sectors from healthcare, business, education, etc. to create solutions that address problems in those sectors.

In the education sector, policy makers are calling for technology companies to build tools to help students improve their mastery of academic skills. (Department of Education, 2018). Helping students to improve mastery of academic skills will require motivating the students to acquire those skills. Motivation is important for learning and staying engaged with learning material. Motivation helps determine how engaged students are in their work, how hard they work, and how well they persevere in the face of challenges (Hiadden & Mckay, 2015). Motivation can be broken down broadly into two types; Intrinsic and Extrinsic motivation.

Intrinsically motivated behavior can be defined as behavior undertaken for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes. (Lepper, 1988). In other words, intrinsic motivation to do something comes from inner satisfaction or enjoyment of the task. Extrinsically motivated behavior, by contrast, involves actions undertaken to obtain some reward or to avoid some punishment external to the activity itself (Lepper, 1988).

A growing body of evidence suggests that when students are intrinsically motivated they tend to master learning content better and they process information more deeply (Lumsden, 2018). On the other hand, extrinsically motivated students may not learn content on a deep level to retain it long after the reward (e.g. good grades) has been gotten. Studies show that increasing students' intrinsic motivation and keeping them motivated is a considerable challenge. (Hiadden & Mckay, 2015).

To increase student intrinsic motivation and improve learning outcomes, teachers adopt pedagogical strategies that can help engage students more. Some of those strategies include the use of videos and images, simulations, games, real world projects and real-world problems.

The instructors' presentation style and behavior can also influence students' engagement. For instance, an instructor can pay more attention to students, provide better feedback and project energy and enthusiasm when presenting the material to engage students better. The following section will discuss some of the pedagogical strategies that instructors use to enhance learning.

Use of images and interactive videos
Images and interactive lesson videos could be used to increase engagement with learning material. Images, videos and animations are used in online distance education platforms in addition to other learning resources to facilitate learning. Videos can feature embedded quizzes, links to additional external learning resources or links to interactive 3D objects for learning (Kolås, 2015). Images, videos and animations could be used to visually present relevant examples that can help students relate theoretical principles to practice. (Moreno & Ortegano-Layne, 2008).

One advantage of using videos is that they can facilitate mastery learning because students may view the videos as many times as required. (Galbraith, 2004). Videos broken down into small, manageable chunks are easier for students to consume and digest (What is Visual Learning?, 2018). This also means that they can be reused as many times as possible by a large number of people, and only require minor updates from time to time.

Some disadvantages of using video content can arise from the structure and the production. Producing educational videos can be difficult and time consuming. It may require expensive equipment and professionals. Moreover, if the video content is not properly structured to convey learning concepts then it can be distracting for students. For distance learners in remote locations, video may be difficult and expensive to stream because of lack of connectivity or high cost of internet connection. Lastly, without interactivity, students may become passive consumers of the content and will not be engaged with it.

Use of simulations (Simulation based learning)

Simulations are used to mimic some real-world phenomena. Simulations create stripped down environments that students can interact with and visualize the results of their interactions. Simulations allow students to engage with the model of the environment so students can try out different environment variables and instantly see the results. Simulations are similar to games because they model some virtual environment but they are more focused on the results of adjustments to variables of the underlying model of the environment. Simulations can be used to carry out experiments that would otherwise be resource intensive, time consuming or dangerous to carry out in the real world (Joyner, 2018). E.g. It may take a lot of time (months to years) and resources to study the effect of global warming on the environment but simulations can make it possible to visualize the results in a fraction of the time. In healthcare simulations can be used to teach health professionals' knowledge, skills, and attitudes, whilst protecting patients from unnecessary risks (Lateef, 2010). Simulations can help students focus on relevant variables for the learning task at hand while removing irrelevant details.

However, simulation-based learning has been found to be somewhat difficult for novice learners because the students often have a hard time establishing goals and their results in learning through simulations. (Simulation-Based Learning, 2018). Moreover, simulations can be expensive to create and maintain.

Project based learning

Project-based learning is a constructivist learning strategy that organizes learning around projects. (Thomas, 2018). Unlike traditional classroom setting where students work on small assignments and topics, project-based learning approach is a technique that engages students through a long term, real world project. The projects are usually based on a driving question which encompasses worthwhile content that is meaningful and anchored in a real-world situation. (Krajcik & C.BlumenFeld). The kind of tasks that students work on during a project is usually similar to the kind of tasks they will perform in the real world thus students get an authentic learning experience.

Project based learning enhances the quality of students' learning, how well they understand the learning content and the students' ability to apply knowledge to novel situations in the real world. (Thomas, 2018)

However, learning projects can be difficult to plan and carry out. They can take a very long time to complete and students may not have enough time allocated to the course/project. For complex projects some students may have difficulty managing their time effectively or using technology productively (Thomas, 2018).

Problem based learning

It is a constructivist learning approach in which learners are actively engaged in working at tasks and activities which are authentic to the environment in which they would be used. (Savery & Duffy, 2001).

Problem based learning is similar to project-based learning because students learn content in the context of how it will be used in the real world. Project based learning and problem-based learning differ in scope; project-based learning scope is usually more board and may take more time. Medical schools in the US and some developing countries use problem-based learning strategy for teaching. It encourages self-sufficiency, promotes active and deep learning and has positive effects on graduate competencies in important social and cognitive domains. (Wood, 2008).

Some challenges in problem-based learning may deal with control; the fact that teachers have to become facilitators of learning and allow students to explore and learn for themselves. Furthermore, teachers may find it challenging to assess the competence of students since traditional tests may not be appropriate for assessing students working on different problems.

Game based learning

Using games to teach could make learning fun, motivate students, help them pay attention and stay focused on the subject (Why Use Games to Teach, 2018). Interactive computer games for learning can considerably improve both knowledge of the embedded subject matter and student enjoyment (Papastergiou, 2009). Educational games are now being applied to teaching various concepts in finance, business (Hindle, 2002), economics (Wolfe, 1985), science, math and languages (YOLAGELDİLİ & ARIKAN, 2011).

One of the main advantages of computer games is their ability to simulate virtual environments and give gamers an environment where they can make mistakes and eventually learn. (Simkova, 2014). However, it could be time

consuming to find a good educational game for learning a subject or topic of interest. Relying solely on search engines to discover educational games may not be good enough so there is need to find a more effective way.

Problem description

From all the literature available, it seems there is considerable effort to bring more educational games into the classroom in the future. However, there are limited resources available that teachers can use to discover and/or recommend games for teaching specific subject topics. Without any kind of structure, recommendation or guidance, teachers looking to incorporate games in their teaching may find it difficult to know the appropriate games for teaching a topic from syllabus. Also, students may find the process of discovering educational games more difficult.

Existing solutions

To discover appropriate games for teaching subjects and topics, teachers currently rely on internet search results or recommendation from peers. Peer recommendation could be very reliable but peers usually recommend resources based on experience which could be limited as the use of games in the classroom is relatively new. On the other hand, internet search results could turn up with a lot of information from blogs, online market places and app store listings. However, it could be intimidating and time consuming to find relevant information from thousands of results. Moreover, even after following a link to a to a website or blog from the search results, the educational game listings on websites often do not have any categorization filter that could enable a teacher to discover games by subject, topic and ratings. Some examples of online sources for educational games include app stores and websites like http://teacherspayteachers.com, http://www.teachersdiscovery.com , etc.

Solution

To help make educational game discovery and adoption easier for teachers and learners, I designed and implemented a mobile compatible (responsive) web application that enables teachers and students to find and recommend games for teaching and learning various subject topics. Generally, users (teachers and learners) are able to submit ratings and reviews for games. The web application features a listing of educational games, their ratings (from teachers and learners), the topics they are meant to teach, and download links from their respective creators. Where a download link is unavailable, then the link points to a relevant gameplay or information page on the vendors website. Newly registered users will be able to start submitting games or reviews for already listed games.

Design and development

Application source code was managed using GIT and Bitbucket code repository service. The application was implemented using Grails web application framework.

The application runs on Apache tomcat and all the application data is persisted to MySQL database. The infrastructure is hosted on Microsoft Azure. Apart from offering all the services required for deploying the app, there was no specific reason for selecting Microsoft Azure cloud. The web application can be reached by following the url: http://learnercube.com

METHODOLOGY

Survey

A survey was used to gather feedback from users about the game discovery web application and to learn about their general gaming habits. The survey respondents were drawn from Georgia institute of technology's online masters in computer science community.

The survey questions include the following:

- Age: select your age group
- On a scale of 1 – 5 where 5 is 'very often' and 1 is 'never', how often do you play educational games.
- On a scale of 1 – 5 where 5 as 'very often' and 1 is 'never', how often do you play regular games?
- On a scale of 1 – 5 where 5 is 'very easy to navigate' and 1 is 'difficult to navigate', rate your experience navigating learnercube.
- What features could be added to increase the utility of this app?

The survey was created and distributed via Georgia Techs' peersurvey website.

Results

The survey received 25 responses. 44% of the respondends were between the age of 18-29, another 44% were between the age of 30-39. 8% were between the age of 40-49 and people between the age of 50-64 made up 4% of the total.

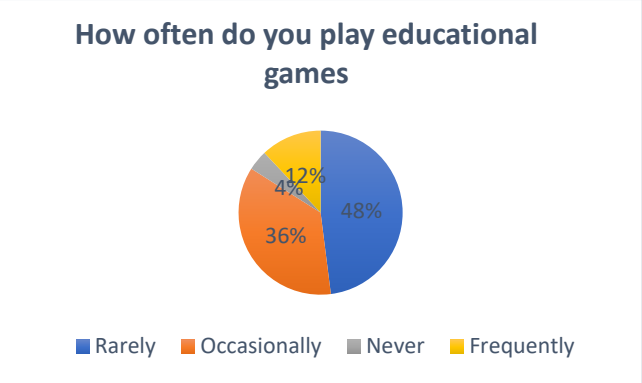
Age Group	Response count
18-20	11
30-39	11
40-49	2
50-64	1

From the survey responses, 8% said they do not play games, 16% reported that they rarely play games, while 40%, 16% and 20% reported that they, respectively, play games occasionally, frequently, and very frequently.

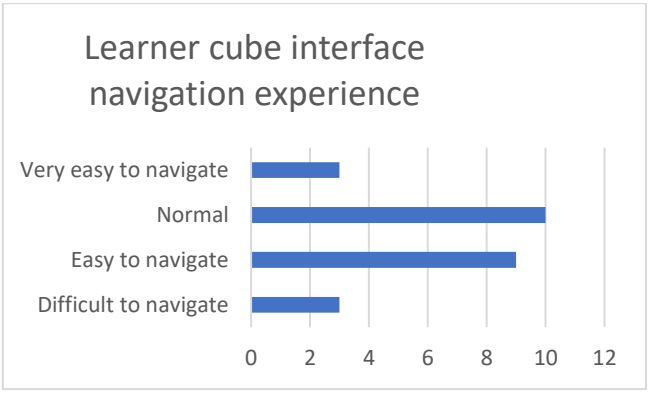
How often do you play regular games?	Response count
Never	2
Rarely	4
Occasionally	10
Frequently	4
Very frequently	5

From the data, more people play regular games than those that do not. However, it is a little different for educational games. 4% have never played any educational game, 48% rarely play, 36% of the respondents reported that they play occasionally, 12% of the respondents frequently play, and 0% reported that they play very frequently.

How often do you play educational games	Response count
Never	1
Rarely	12
Occasionally	9
Frequently	3
Very Frequently	0



From the survey there was some feedback about the web site navigation and feature requests. One feedback suggested the addition of a search filter and another suggested the implementation of a 'smart' recommendation system for educational games. All the feedback was aggregated and will help with further development and improvement of the app. Most of the users reported that the web application was at least easy to navigate. However, 12% of the respondents said the app was difficult to navigate.



Limitations

The feedback was gotten from only 25 respondents, so it may not be representative enough. We found that more people played regular games than educational games but the survey questions did not account for the reason.
Furthermore, the game discovery web app is still in its infancy so it may be too early to gauge its impact on adoption of educational games by students and teachers.

Future work

For now, there are only two ways to get new educational game listings on the website; either through someone with administrator access or through a registered user. One survey respondent suggested implementing a module that will auto populate the web app by scraping other public sources on the internet. That idea may be worth pursuing. Another feature that may be worth implementing is a game recommendation engine that will recommend games based on user profile, subject and topic lists.

Conclusion

This paper highlighted some common pedagogical strategies for improving student intrinsic motivation to learn and also discussed some of the similarities between the strategies. It then focused on game-based learning and discussed the implementation of a web app that will make the process of educational game discovery easier. Survey results revealed that more people play regular games than educational games. Although it is not yet clear why the numbers differ for regular games vs educational games, it may be because people do not have an effective way of discovering educational games. A web application that makes it easy to discover and play educational games may help increase the adoption of educational games in the classroom.

REFERENCES

Department of Education. (2018, 06 1). EdTech Developers guide. United States of America. Retrieved from Office of Educational Technology: https://tech.ed.gov/developers-guide/

Galbraith, J. D. (2004). Active viewing: and oxymoron in video-based instruction? *Society for Applied Learning Technologies Conference.*

Hiadden, S., & Mckay, S. (2015). *Motivation matters, How new research can help teachers boost student engagement.* California: Carnegie Foundation for the Advancement of Teaching. Retrieved from https://www.carnegiefoundation.org/blog/using-new-research-to-improve-student-motivation/

Hindle, K. (2002). A Grounded Theory for Teaching Entrepreneurship Using Simulation Games. *Simulation and Gaming*, 236-241 .

Joyner, D. (Director). (2018). *Introduction to simulation based learning* [Motion Picture].

Kolås, L. (2015). Application of interactive videos in education. *015 International Conference on Information Technology Based Higher Education and Training (ITHET)*, (pp. 1-6). Lisbon.

Krajcik, J. S., & C.BlumenFeld, P. (n.d.). Project based learning. 317-333.

Lateef, F. (2010). Simulation-based learning: Just like the real thing. *Journal of Emergency Trauma, and Shock*, 348–352.

Lepper, M. R. (1988). Motivational Considerations in the Study of Instruction. *Cognition and Instructio*, 289-309.

Lumsden, L. S. (2018, 6 7). *Student Motivation To Learn.* Retrieved from ERIC: https://eric.ed.gov/?id=ED370200

Moreno, R., & Ortegano-Layne, L. (2008). Do classroom exemplars promote the application of principles in teacher education? A comparison of videos, animations, and narratives. *Educational Technology Research and Development*, 449–465.

Papastergiou, M. (2009). Digital Game-Based Learning in high school Computer Science education: Impact on educational effectiveness and student motivation. *Computers & Education*, 1-12.

Savery, J. R., & Duffy, T. M. (2001). *Problem Based Learning: An instructional model and its constructivist framework.* Bloomington: Center for Research on Learning and Technology, Indiana University.

Simkova, M. (2014). Using of Computer Games in Supporting Education. *Elsevier*, 1224-1227.

Simulation-Based Learning. (2018, June 8). Retrieved from Learning Theories: https://www.learning-theories.org/doku.php?id=instructional_design:simulation-based_learning

Thomas, J. W. (2018, June 8). *A REVIEW OF RESEARCH ON PROJECT-BASED LEARNING*. Retrieved from Bob Pearlman: http://www.bobpearlman.org/BestPractices/PBL_Research.pdf

What is Visual Learning? (2018, 06 07). Retrieved from Zane Education: http://www.zaneeducation.com/visual-learning/visual-learning.php

Why Use Games to Teach. (2018, 06 1). Retrieved from Starting point: Teaching Entry level geoscience: https://serc.carleton.edu/introgeo/games/whygames.html

Wolfe, J. (1985). The Teaching Effectiveness of Games in Collegiate Business Courses. *Simulation & Gaming*, 251 - 288 .

Wood, D. F. (2008). Problem based learning . *BMJ (Clinical research ed.)*, 971.

YOLAGELDİLİ, G., & ARIKAN, A. (2011). Effectiveness of Using Games in Teaching Grammar to Young Learners. *Elementary Education Online*, 219-229.